CLAIMS

I claim:

1. A device for separating magnetic or magnetizable particles from a liquid by using a magnetic field, the device comprising:

two limbs made of a soft-magnetic material, each limb forming a magnetic pole;

an air gap between the two poles of the limbs, the air gap being suitable for receiving at least one container;

a head piece arranged in a fixed or detachable manner on one of the two poles and at least one magnetizable bar disposed vertically in a fixed or movable manner on the head piece;

at least one permanent magnet movably arranged on at least one point of the device for producing a magnetic field between the two poles, wherein the magnetic field is activated or deactivated by moving the magnet; and

a material arranged at least partially surrounding a region of the device where the at least one movable magnet is located to screen the magnetic field.

2. The device according to claim 1, wherein the two limbs are connected with each other at a side opposite the poles, thereby forming a magnetic circuit.

3. The device according to claim 2, wherein the at least one movable magnet is arranged to be movable within the magnetic circuit.

4. The device according to claim 3, wherein the magnet is rotatable within the magnetic circuit.

5. The device according to claim 2, wherein the at least one movable magnet is arranged to be movable into the magnetic circuit from outside and then again out of the magnetic circuit.

6. The device according to claim 1, wherein the at least one movable magnet is arranged to be rotatable or tiltable in a recess of the device provided for that purpose.

7. The device according to claim 1, wherein the at least one movable magnet is arranged in a displaceable manner in a recess of the device provided for that purpose.

8. The device according to claim 5, wherein the at least one movable magnet is arranged on a rotatable support by which the at least one movable magnet can be moved into the magnetic circuit and then again out of the circuit.

9. The device according to claim 1, wherein movement of the at least one movable magnet is accomplished by an electric motor, pneumatic or hydraulic drive.

10. The device according to claim 1, wherein an extent of movement of the at least one movable magnet can be predetermined to set a magnetic field strength to a desired value.

11. The device according to claim 1, wherein a region of the magnetic circuit in which the at least one movable magnet is arranged is completely surrounded by the material which screens the magnetic field, the screening being provided in a form of a short circuit ring.

12. The device according to claim 1, wherein the head piece is movable in a horizontal plane for carrying out a shaking motion.

13. The device according to claim 1, wherein the head piece carries a plurality of the magnetizable bars arranged in rows.

14. The device according to claim 1, wherein the head piece is attached to one of the two poles in a detachable manner.

15. The device according to claim 1, wherein the at least one magnetizable bar is arranged in a rotatable manner and is rotatable around a longitudinal axis by an electromotive drive.

16. The device according to claim 1, wherein the at least one magnetizable bar is covered with a strippable, replaceable envelope.

17. The device according to claim 1, wherein at least one holder for the at least one container is associated with the device, the at least one holder being suitable for positioning the at least one container below the head piece and the bars arranged thereon.

18. The device according to claim 17, wherein the at least one holder is movable in a horizontal plane and/or vertically by an electromotive, pneumatic or hydraulic drive.

19. The device according to claim 18, wherein the at least holder is adapted for carrying out shaking movements.

20. The device according to claim 17, wherein the at least holder is a component of a program-controlled laboratory robot system adapted to are alternately move groups of or a plurality of individual ones of the containers into a position below the bars and subsequently, after a predetermined time interval, again into a position outside the region below the bars, and wherein the groups or plurality of containers comprise microtiter plates.

21. The device according to claim 18, wherein the at least one holder is moved vertically, the vertical movement being controlled by an open-loop control unit or a closed-loop control unit, such that an upward movement of the at least one holder causes an immersion of the bars into liquid in the at least one container.

22. The device according to claim 1, further comprising a program-controlled processor associated with the device and connected thereto, by which at least one of the following functions of the device is controlled by open-loop control or closed-loop control, or by which at least two of the following functions are coordinated with one another:

movement of the at least one movable magnet to activate and deactivate the magnetic field, including at least one of duration of activated and deactivated phases, and magnetic field strength;

rotation speed and duration of rotation of rotatable bars;

movement of the head piece in a horizontal plane, including at least one of duration, frequency and amplitude of a shaking motion;

movement of the at least one holder to position the at least one container alternately below the bars and subsequently to remove the at least one container from that position, including at least one of velocity and frequency of the movement and dwell time of the at least one holder below the at least one bar;

vertical movement of the at least one holder to immerse the at least one bar into the liquid of the at least one container and remove the liquid from the at least one container, including immersion depth, duration and frequency of the vertical movement; and

rotation or shaking motion of the at least one holder, if provided, including rotation speed, rotation amplitude and intervals between individual operation phases of the rotation or shaking motion.

23. The device according to claim 1, further comprising at least one of the following means associated with the device, wherein functions of the means are coordinated with functions of the device by a common control:

at least one thermostattable heating or cooling means;

at least one pipetting station for metered addition of liquids including reagents;

at least one suction means for exhausting liquid from the at least one container by suction;

at least one means for shaking or intermixing liquids contained in the at least one container; and

analytic apparatuses for photometric measuring or luminescence detection.

24. A method for separating a target substance from a mixture of substances present in liquid form, the method comprising the following steps:

a) adding to the mixture magnetic or magnetizable particles having specific binding properties in relation to the target substance;

b) placing a pre-determined volume of the mixture in an air gap between two poles of a magnetic circuit and immersing a magnetizable bar into the mixture, the bar being connected with one of the poles of the magnetic circuit, and a magnetic field of the circuit being initially deactivated;

c) activating the magnetic field by changing a position of a permanent magnet arranged in or on the magnetic circuit, the change of position causing the bar to be magnetized and the particles to accumulate at and substantially adhere to a lower end of the bar;

d) immersing the bar, together with the particles adhering thereto, into a predetermined volume of a liquid that causes elution of the target substance from the particles; and

e) lifting the bar from the elution liquid.

25. The method according to claim 24, wherein, following step d), the following steps are performed:

f) deactivating the magnetic field by an opposite change of the position of the permanent magnet, such that the particles are released into the elution liquid;

g) mixing the particles in the elution liquid;

h) activating the magnetic field by changing the position of the permanent magnet such that the bar is magnetized and the particles accumulate at and substantially adhere to the lower end of the bar; and

i) lifting the bar from the elution liquid.

26. The method according to claim 24, wherein, following step c), the following steps are performed:

k) immersing the bar, together with the particles adhering thereto, into a pre-determined volume of a wash liquid;

l) deactivating the magnetic field by an opposite change of the position of the permanent magnet, such that the particles are released into the wash liquid;

m) mixing the particles in the wash liquid;

h) activating the magnetic field by changing the position of the permanent magnet such that the bar is magnetized and the particles accumulate at and substantially adhere to the lower end of the bar;

l) lifting the bar from the wash liquid; and

m) eluting the target substance as in steps d) and e).

27. A method for separating a target substance from a mixture of substances present in liquid form using the device of claim 1.